

CLAIMS

What is claimed is:

- 1 1. An elevated pressure and temperature fluid processing system
2 comprising:
 - 3 a pressurized fluid delivery system including a process fluid supply
 - 4 system and pump for supplying a process fluid at a pressure of at least a
 - 5 process pressure, and a process fluid heater for heating said process fluid;
 - 6 a process chamber with a process chamber heater; and
 - 7 a process discharge collection system;
 - 8 a process chamber inflow valve for connecting said pressurized fluid
 - 9 delivery system to said process chamber for fluid flow;
 - 10 a process chamber outflow valve for connecting said process
 - 11 chamber to said collection system for fluid flow;
 - 12 a process chamber bypass valve for connecting said pressurized fluid
 - 13 delivery system to said process discharge collection system so as to bypass
 - 14 said process chamber; and
 - 15 a computer control system controlling said pump, said process fluid
 - 16 heater, said chamber heater, and said valves.
 - 17
- 1 2. The system according to claim 1 wherein said pressurized fluid delivery
2 system comprises a process fluid re-circulation system, and wherein said
3 pump functions continuously.
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- 1 3. The system according to claim 2 wherein said process fluid re-
2 circulation system comprises:
 - 3 a first valve whereby said process fluid supply system and pump are
 - 4 isolated from said first process fluid heater and said chamber when said
 - 5 first valve is closed;
 - 6 a check valve disposed between said process fluid re-circulation
 - 7 system and a process fluid source;

8 a temperature control device whereby said process fluid is
9 maintained in a liquid phase;
10 a re-circulation loop whereby said process fluid in said liquid phase
11 is directed through said temperature control device and said pump.
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1 4. The system according to claim 1, said process discharge collection
2 system further comprising a recovery volume connecting to said process
3 chamber for receiving a rapid discharge of process reagents from said
4 process chamber, and recovery volume control valves for selecting and de-
5 selecting said recovery volume from said process discharge collection
6 system, said recovery volume control valves being controlled by said
7 computer control system.
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1 5. The system according to claim 1, said chamber heater comprising a
2 heating subsystem with inflow and outflow lines connecting a source of a
3 preheated heat transfer medium to at least one heat exchanger in said
4 process chamber and control valves for controlling the circulation of said
5 preheated heat transfer medium through said heat exchanger, said control
6 valves being controlled by said computer control system for achieving a
7 desired heating effect within said chamber.
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1 6. The system according to claim 1, said process fluid being carbon
2 dioxide.
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1 7. The system according to claim 1, said process being a supercritical
2 phase process for cleaning and processing devices chosen from the group of
3 devices consisting of semiconductor wafers, masks, light emitting diodes,
4 and disk drive components.
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1 8. The system according to claim 1 further comprising:

2 a pressurized additives delivery system including an additives supply
3 system and pump for supplying additives at a pressure of at least said
4 process pressure, and an additives heater for heating said additives to a
5 pre-process temperature suitable for mixing with said process fluid;

6 a directional valve and mixer disposed between said process fluids
7 heater, said process chamber, and said additives heater;

8 said additives heater and said directional valve being controlled by
9 said computer control system;

10 said pressurized fluid delivery system and said pressurized additives
11 delivery system being connected to said directional valve such that a
12 computer controlled ratio of process fluids and additives can be admitted
13 into said mixer and heater at selected respective temperatures.

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1 9. The system according to claim 8 further comprising:

2 a mixture heater;

3 said mixture heater being disposed between said mixer and said
4 process chamber; and

5 said mixture heater heating said mixture to at least a process
6 temperature.

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1 10. The system according to claim 8 wherein said pressurized additives
2 delivery system comprises an additives re-circulation system, and wherein
3 said pump functions continuously.

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1 11. The system according to claim 10 wherein said additives re-circulation
2 system comprises:

3 a first valve whereby said additives supply system and pump are
4 isolated from said additives heater and said mixer when said first valve is
5 closed;

6 a check valve disposed between said additives re-circulation system
7 and an additives source;

8 a temperature control device whereby said additives are maintained
9 at a selected temperature;

10 a re-circulation loop whereby said additives are directed through said
11 temperature control device and said pump.

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1 12. The system according to claim 3, said process discharge collection
2 system further comprising at least one separator for separating phases and
3 constituents from the process discharge.

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1 13. The system according to claim 12, further comprising a return line from
2 said collection system to said pressurized fluid delivery system.

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1 14. The system according to claim 12, further comprising a return line from
2 said collection system to said pressurized additives delivery system.

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1 15. The system according to claim 8 wherein said additive heater, said
2 process chamber heater, and said process fluid heater are each selected
3 from the group of heaters consisting of heat exchangers and electric
4 resistance heaters.

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1 16. A system for the supply of elevated pressure and temperature fluid to a
2 process system, said system comprising:

3 a pressurized fluid delivery system including a process fluid supply
4 system and pump for supplying a process fluid at a pressure of at least a
5 process pressure, and a process fluid heater for heating said process fluid
6 to a process fluid mixing temperature;

7 a pressurized additives delivery system including an additives supply
8 system and pump for supplying additives at a pressure of at least said

9 process pressure, and an additives heater for heating said additives to a
10 additive mixing temperature suitable for mixing with said process fluid;
11 a directional valve, disposed between said process fluids heater, said
12 additive heater and the process system, said process fluid heater, said
13 additives heater, said directional valve being controlled by a computer
14 control system; and
15 said pressurized fluid delivery system and said pressurized additives
16 delivery system being connected to said directional valve such that a
17 computer controlled ratio of process fluids and additives can be admitted
18 through said mixing valve.

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1 17. The system according to claim 16 further comprising a mixer, said
2 mixer being disposed between said mixing valve and the process system.

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1 18. The system according to claim 17 wherein said mixer is chosen from
2 the group of mixers consisting of static and dynamic mixers.

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1 19. The system according to claim 17 further comprising:

2 a mixture heater;
3 said mixture heater being disposed between said mixer and the
4 process system; and
5 said mixture heater heating said mixture to at least a process
6 temperature.

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1 20. The system according to claim 19 wherein said process temperature
2 induces a phase change in at least said process fluid from a liquid phase to
3 a supercritical phase.

1 21. The system according to claim 17 further comprising a shunt disposed
2 between said mixer and the process system, for selectively diverting said
3 process fluid and additives from the process system.

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1 22. The system according to claim 16 wherein said process fluid mixing
2 temperature is at least equal to a process temperature.

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1 23. The system according to claim 16 wherein said process fluid mixing
2 temperature induces a phase change in said process fluid from a liquid
3 phase to a supercritical phase.

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1 24. A method for mixing additives to a process fluid in a high pressure and
2 temperature fluid processing system comprising the steps:

3 maintaining a supply of process fluid at a pressure of at least a
4 process pressure in communication via a common conduit with a pressure
5 vessel;

6 maintaining a supply of additives in a fluid form at a pressure of at
7 least said process pressure in communication with said pressure vessel via
8 said common conduit;

9 adjusting the temperature of said supply of process fluid for a first
10 desired mixing temperature;

11 adjusting the temperature of said supply of additives in fluid form
12 for a second desired mixing temperature; and

13 admitting respective flows from respective supplies of said process
14 fluid and said additives at a selected ratio into said common conduit so as
15 to have a mixture flowing in said common conduit.

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1 25. The method according to claim 24, further comprising adjusting the
2 temperature of said mixture to a desired process temperature.

1 26. The method according to claim 24, further comprising the steps:
2 arranging a bypass valve disposed in said common conduit for
3 bypassing said pressure vessel,
4 adjusting said bypass valve so as to direct said mixture into
5 said pressure vessel when said mixture reaches said desired
6 process temperature and a homogenous state.